NC Distributed Generation Interconnection and Net Metering

Environmental and Economic Benefits
of Capturing Swine Manure Methane Workshop
September 18, 2008
Clinton, North Carolina

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Advancing Renewable Energy for a Sustainable Economy

North Carolina Solar Center

An Inclusive Interest in Energy Efficiency and Renewable Energy

Renewable Energy

- **Solar** (photovoltaics, solar hot water, passive solar, daylighting)
- **Wind**
- **Biomass** (animal waste, energy crops, landfill gas)
- **Biofuels** (ethanol, biodiesel)
- **Hydrogen & Fuel Cells**

Energy Efficiency

- **Green Buildings & Sustainable Design**
- **CHP & Distributed Generation**
- **NC Industries of the Future**

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SOUTHEAST CHP APPLICATION CENTER

Advancing Renewable Energy for a Sustainable Economy

NORTH CAROLINA SOLAR CENTER

Major Drivers for NC Renewable Energy & Energy Efficiency

- **Agricultural community** is politically strong and owns renewable energy feedstock
- **Economic development** opportunities for rural regions that need jobs
- **Air quality and climate change** issues make fossil fuel plants less likely
- **Energy security and independence** perceived as critical need for growth in the region

Renewable Energy and Efficiency Portfolio Standard

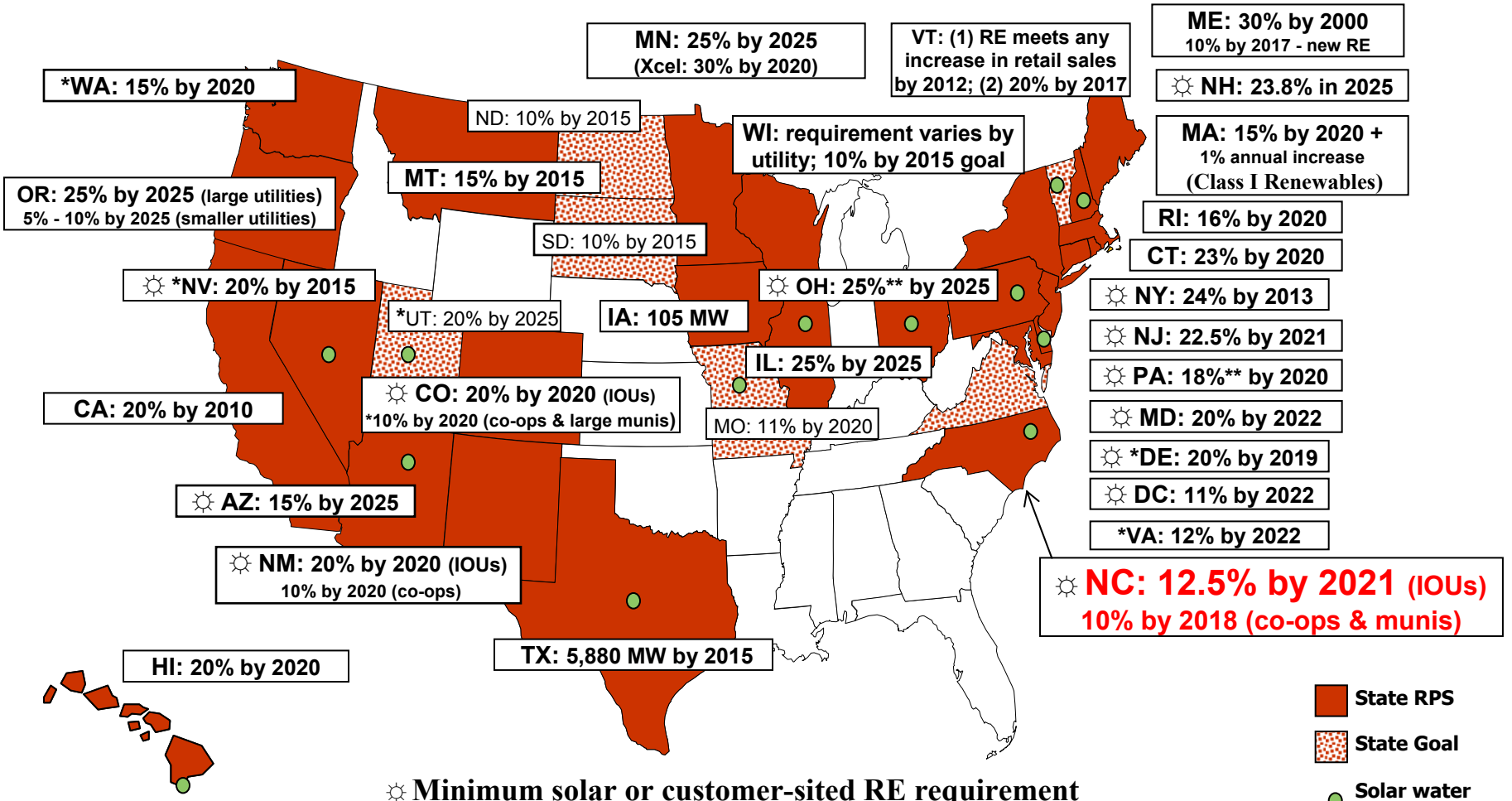
- Senate Bill 3 passed during 2007 Legislative session requires development of renewable energy and energy efficiency resources tailored to NC capabilities. La Capra estimated **93MWyr swine AD**.
- Senate Bill 1465 passed during the same session to establish a Swine Farm Methane Capture Pilot Program which is limited to 50 farms, that must be producing electricity no later than September 2010 and limits the payment for electricity to no more than $0.18 per kilowatt hour, for a maximum of seven years.

http://www.ncuc.commerce.state.nc.us/rps/NCRPSReport12-06.pdf
http://www.ncuc.commerce.state.nc.us/reps/NCRPSEnergyEfficiencyReport12-06.pdf
http://www.engr.ncsu.edu/ncsc/bioenergy/docs/NC_Biomass_Roadmap.pdf

2008

DSIRE: www.dsireusa.org

September 2008



Minimum solar or customer-sited RE requirement

* Increased credit for solar or customer-sited RE

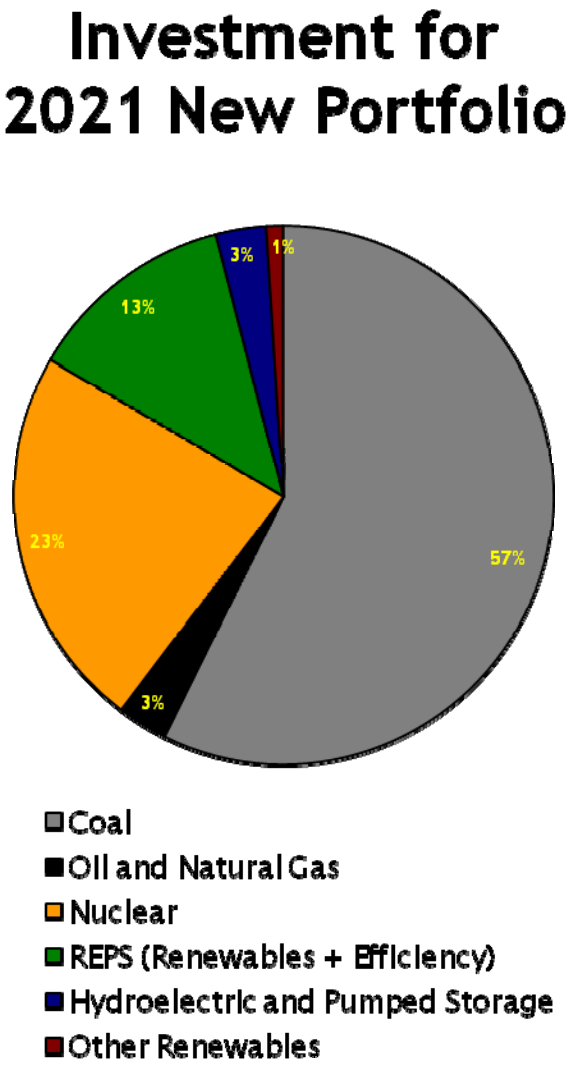
**Includes separate tier of non-renewable "alternative" energy resources

Benefits of REPS for NC

- Economic Benefits (net gain)
  - Rate impact estimated lower than new coal or nuclear
  - 2,000+ net jobs per year
  - $1.5 billion more in wages through 2017
  - $2.7 billion increase in Gross State Product
  - Keeps more $'s circulating in NC economy
- Social Benefits
  - Creates local wealth statewide; close to the land
  - Strengthens rural counties
- Environmental Benefits
  - Helps resolve hog and poultry waste/pollution issues
  - Improves air and water quality
  - *Reduces NC's CO_2 emissions by 13+ million metric tons per year*

This slide from Legislative presentation on REPS, 2005 by Urlaub – sources ASU Energy Center, La Capra/NCUC.

How will NC Utility Portfolio change our energy future?



- The least-cost portfolio
- Ratepayer cost risk is reduced
- All customer classes benefit and all utility suppliers participate
- Barriers are reduced for business ventures in a clean energy market

Renewable Energy and Energy Efficiency Portfolio Standard

Eligible Renewable/Other Technologies: Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Solar Thermal Process Heat, Photovoltaics, Landfill Gas, Wind, Biomass, Geothermal Electric, Hydrogen, ***Anaerobic Digestion***, Small Hydroelectric, Tidal Energy, Wave Energy

Applicable Sectors: Municipal Utility, Investor-Owned Utility, Rural Electric Cooperative

Standard: 12.5% of 2020 retail sales by 2021 for investor-owned utilities; 10% of 2017 retail sales by 2018 for electric cooperatives and municipal utilities

Technology Minimum: 0.2% solar electricity and thermal energy by 2018; ***0.2% swine waste by 2018***; 900,000 MWh of poultry waste by 2014

Key Elements of NC REPS

- Exempts RE systems under 2 MW from obtaining a Certificate of Public Convenience and Necessity from NCUC but require Notice of Intent
- Directs NCUC to increase size of Interconnection Standard to 10 MW
- Suggests that NCUC consider increasing Net Metering Rule to 2 MW
- Applies to all NC electric providers IOU's, EMC's and Muni's

Effective Interconnection Policy

- Sets fair fees that are proportional to project size
- Ensure policies are transparent, uniform, detailed and public
- Allows interconnected net-metered systems 2-MW and larger
- Adopt plug-and-play rules for residential and small commercial scale systems and expedited procedures for other systems
- Process applications quickly, using standardized and simplified forms
- Prohibit restrictive requirements i.e. additional insurance requirements, redundant external disconnect switch

INTERCONNECTION

STATE	Grade
IREC Model	A
New Jersey	B
Arizona	B
California	C
Ohio	C
Texas	C
New York	C
Colorado	C
Oregon*	C
Massachusetts	C
Georgia	C
New Mexico*	C
Vermont	C
Minnesota	C
Rhode Island	D
Wisconsin	D
West Virginia	D
Arkansas	D
New Hampshire	D
Virginia	D
Iowa	D
Maryland*	D
Montana	D
Michigan	D
Indiana	D
Pennsylvania	D
Connecticut	D
North Carolina	F
D.C.	F
Wyoming	F
Louisiana	F
Delaware	F
Hawaii	F
Utah	F
Washington	F
Missouri	F

http://www.newenergychoices.org/uploads/FreeingTheGrid2007_report.pdf

NC's Interconnection Standard

- Upgraded by the NCUC in June 2008, removing the limit on system size and altering the rule on external disconnect switches

- **Eligible Renewable/Other Technologies**: Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Fuel Cells, Municipal Solid Waste, CHP/Cogeneration, Anaerobic Digestion, Small Hydroelectric, Microturbines, Other Distributed Generation Technologies
- **Applicable Sectors**: Commercial, Industrial, Residential, Nonprofit, Schools, Local Government, State Government, Fed. Government, Agricultural, Institutional
- **Limit on System Size/Overall Enrollment**: No
- **Standard Interconnection Agreement?** Yes
- **Additional Insurance Requirements?** No
- **External Disconnect Required?** Not required for systems up to 10 kW; Utility authorized to require for systems greater than 10 kW

DSIRE

http://www.dsireusa.org/

Effective Net Metering Policy

- Provides a billing arrangement where 1-kWh generated by the customer has the exact same value as 1-kWh consumed by the customer
- Allow rollover of excess electricity
- Reduces unnecessary red tape and special fees i.e. standby charges, riders and extra metering cost
- Customer owns Renewable Energy Credits and Carbon Credits from their generation
- Ensures customer receive credit at the utility's full retail rate
- Allow systems over 1MW to net meter
- Does not place restrictive limit on total net metering program capacity

NET METERING

STATE	Grade
IREC Model	A
New Jersey	A
Colorado	A
Pennsylvania	A
Maryland	A
California	A
Oregon	B
Delaware	B
Iowa	B
Nevada	B
Connecticut	B
Ohio	B
New Mexico	B
Arkansas	C
New Hampshire	C
Rhode Island	C
Hawaii	C
Maine	C
Louisiana	C
Virginia	C
North Dakota	C
Minnesota	C
Massachusetts	C
Montana	C
Vermont	C
Missouri	C
Washington	D
New York	D
Texas	D
Kentucky	D
Michigan	D
Wyoming	D
Oklahoma	D
Indiana	D
West Virginia	D
Utah	F
D.C.	F
Georgia	F
North Carolina	F
Wisconsin	F

http://www.newenergychoices.org/uploads/FreeingTheGrid2007_report.pdf

NC's Net Metering Policy

NCUC proceedings are ongoing to consider upgrades to this policy

- **Incentive Type:** Net Metering
- **Eligible Renewable/Other Technologies:** Photovoltaics, Landfill Gas, Wind, Biomass, Anaerobic Digestion, Small Hydroelectric
- **Applicable Sectors:** Commercial, Industrial, Residential, Nonprofit, Schools, Local Government, State Government, Tribal Government, Fed. Government, Agricultural, Institutional
- **Limit on System Size:** 20 kW for residential systems; 100 kW for non-residential systems
- **Limit on Overall Enrollment:** 0.2% of each utility's North Carolina retail peak load for the previous year
- **Treatment of Net Excess:** Credited to customer's next bill at applicable time-of-use rate or less; granted to utility (annually) at beginning of each summer
- **Utilities Involved:** Investor-owned utilities (Progress Energy, Duke Energy, Dominion North Carolina Power)

DSIRE

http://www.dsireusa.org/

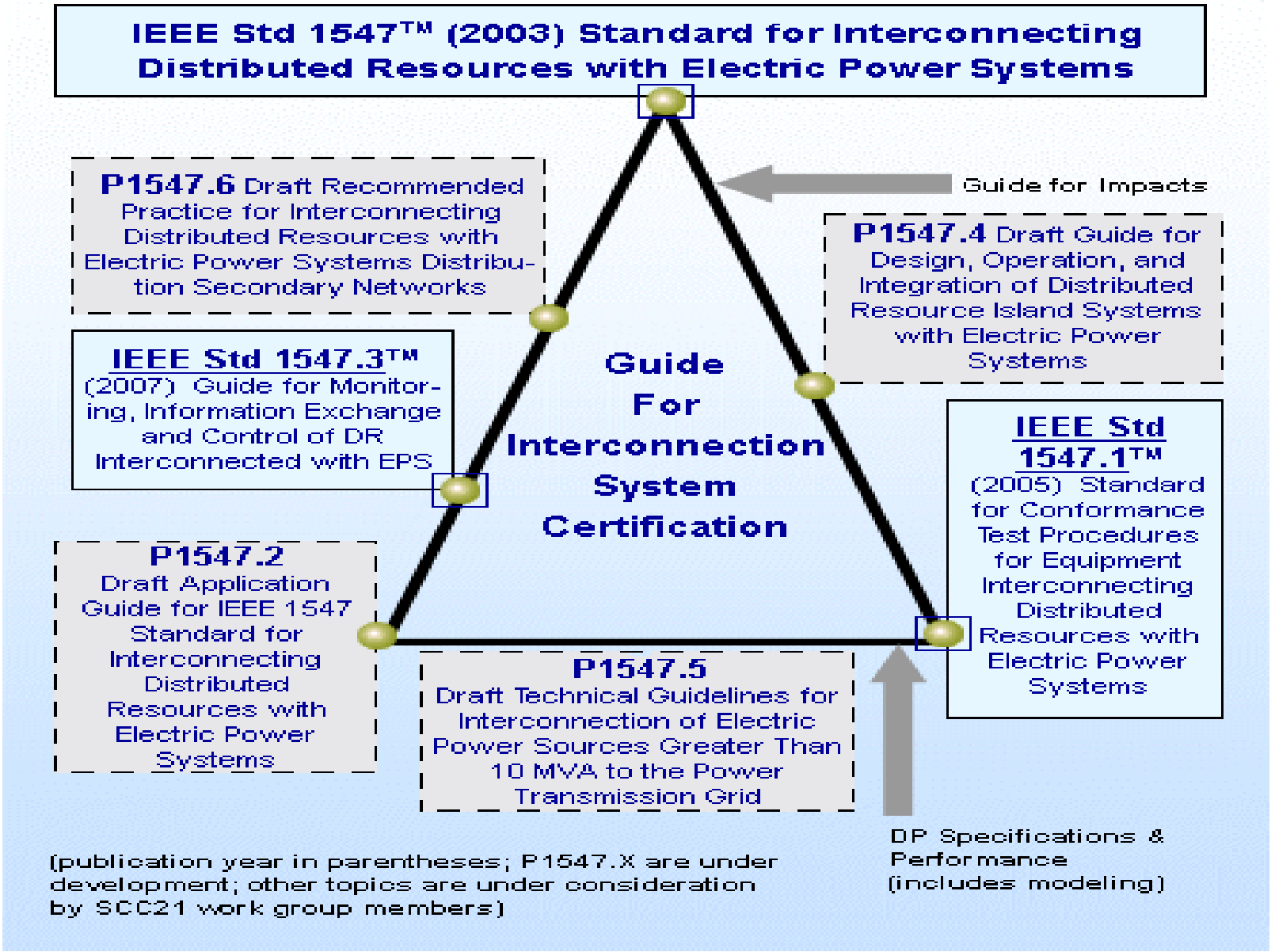
Aspects of Utility Interconnection Guiding Procedures & Standards

- Procedures
  - NC Small Gen interconnection standard (≤ 100 kW), or…
  - FERC SGIP (Small Generator Interconnection Procedures) Order 2006 www.ferc.gov
- Standards
  - IEEE 1547-2003 (& substandards) – grid interaction with respect to:
    - Normal conditions: Voltage, load flow, flicker
    - Abnormal conditions: Fault detection and anti-islanding

IEEE 1547-2003 sections

- NORMAL CONDITIONS
  - Voltage regulation (4.1.1)
  - Isolation device (4.1.7)
- ABNORMAL CONDITIONS
  - Integration with Area EPS grounding (4.1.2)
  - Response to Area EPS abnormal conditions (4.2)
  - Unintentional islanding (4.4.1)
  - Reconnection to Area EPS (4.2.6)
  - Area EPS faults (4.2.1)
  - Area EPS reclosing coordination (4.2.2)
  - Voltage protection (4.2.3)
  - Frequency protection (4.2.4)

IEEE SCC21 1547 Series of Interconnection Standards

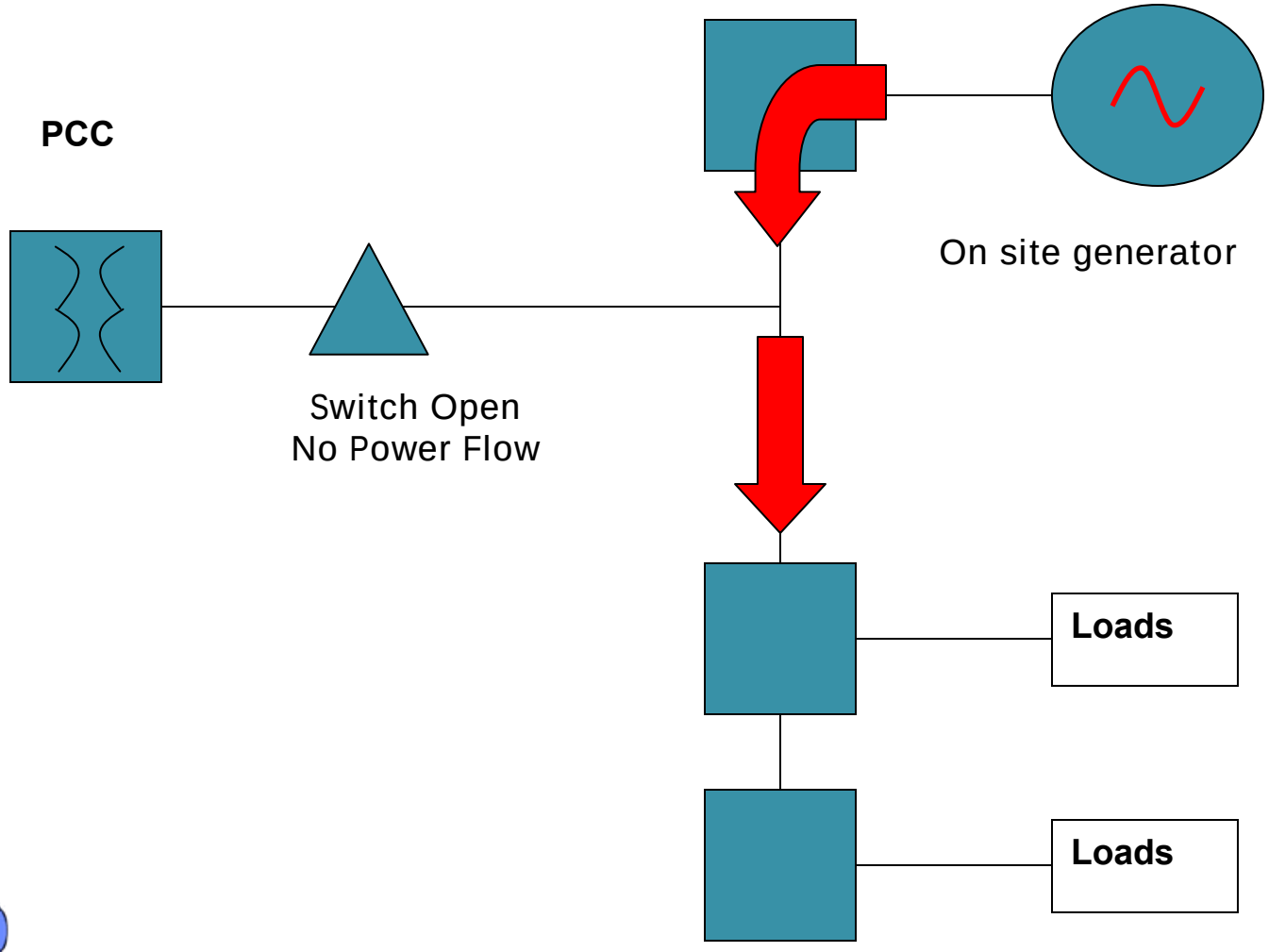


(taken from IEEE's site at http://grouper.ieee.org/groups/scc21/dr_shared/)

Implementation of IEEE 1547

- Still points of contention among NC service providers and DG customers
- See website at **http://www.progress-energy.com/environment/ras/interconnectionprocedures.asp**
- Contact **customer.generation.pec@pgnmail.com**

Grid Isolated



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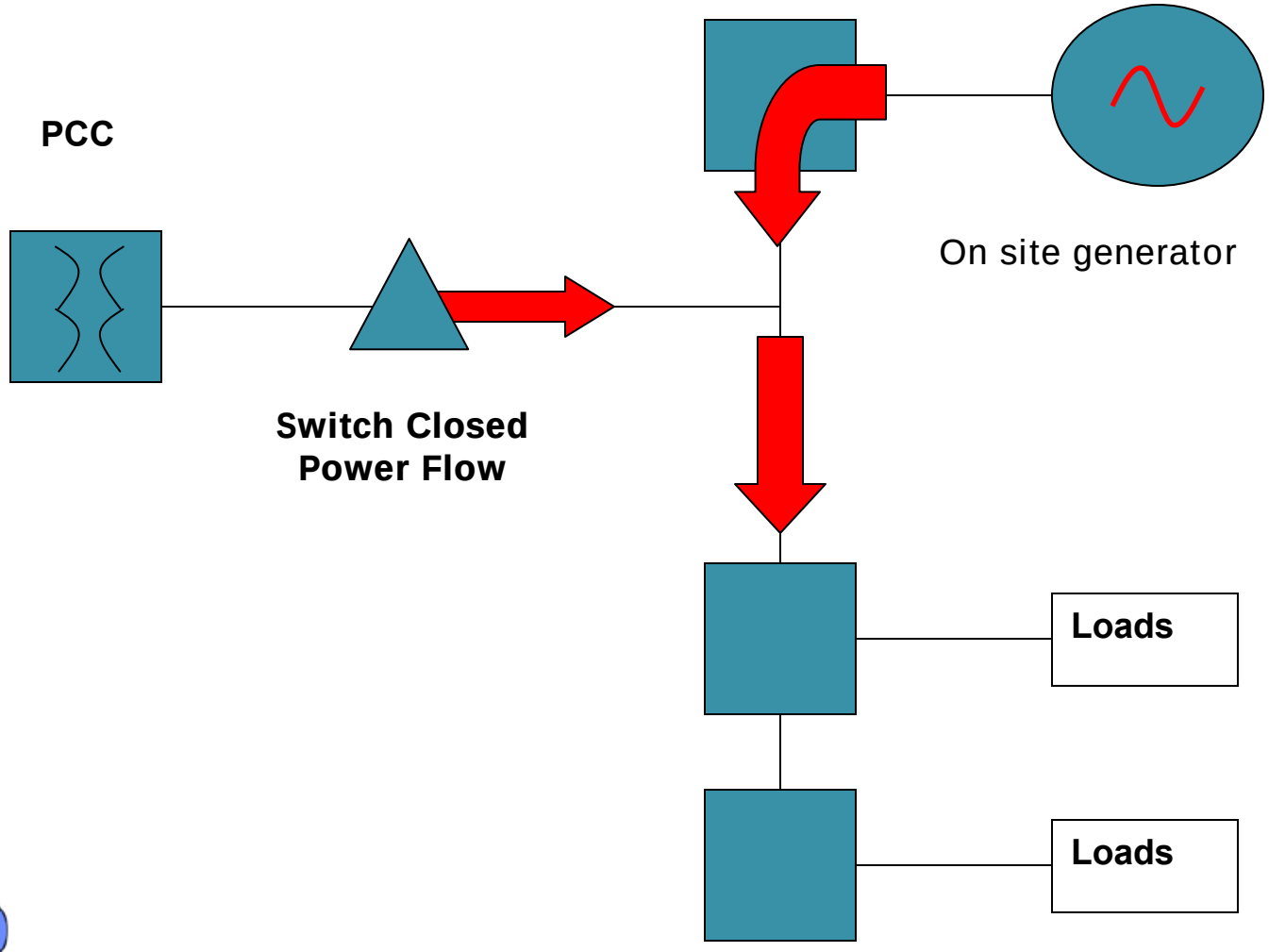

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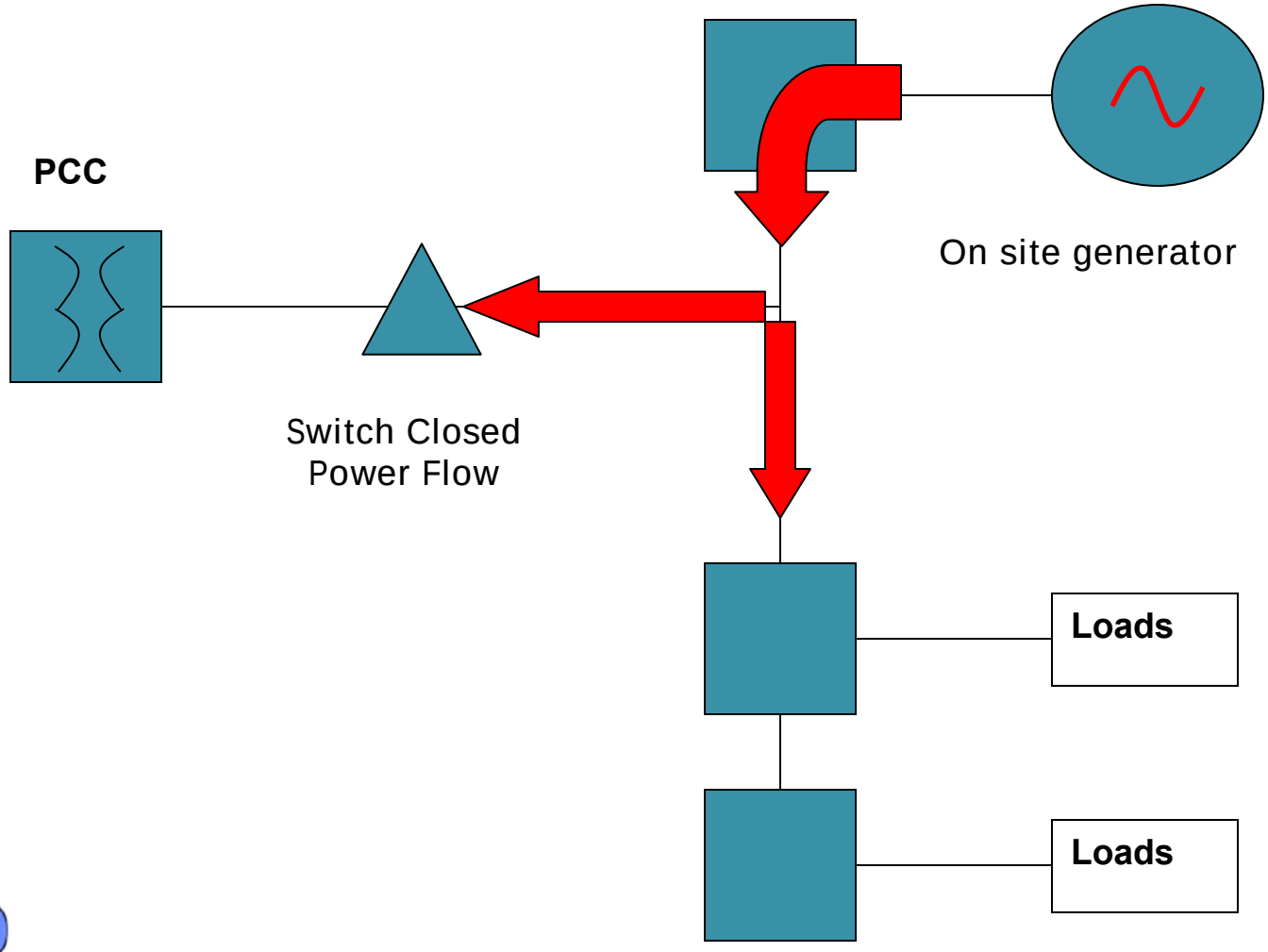
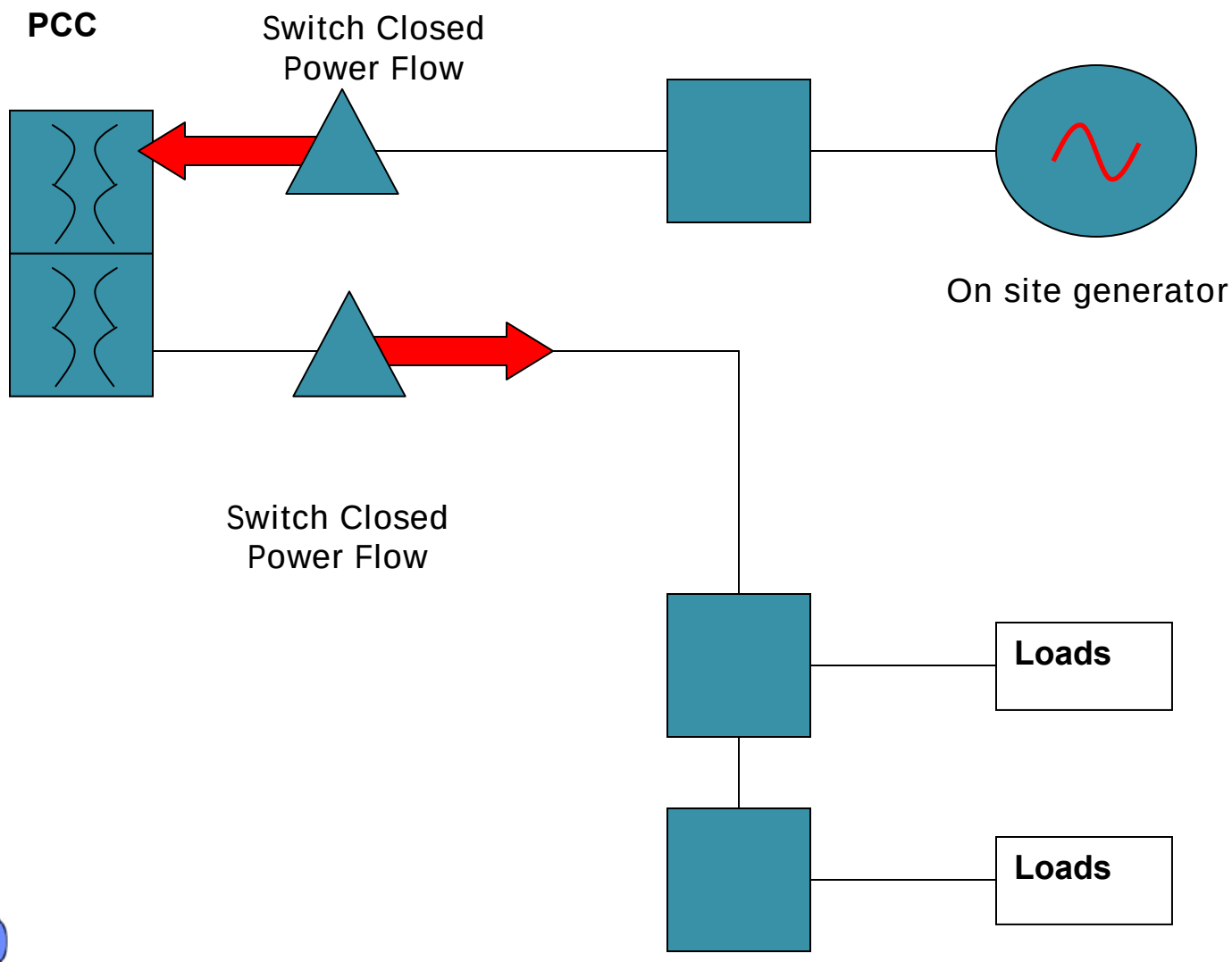


Buy All/Sell All



Typical Generation Agreements

Generation Mode	***Type Generation***	***Agreements****	***Schedules and Riders***
"Sell All"	All types	CSP and Interconnection Agreements	CSP schedule
"Buy All/Sell All"	All Types	CSP, Interconnection, and Retail Agreements	CSP and applicable class retail schedule
"Sell Excess"	PV	Applicable CSP or PV, Interconnection, and Retail Agreements	Applicable CSP or PV schedule, applicable class retail schedule and standby rider
	Other	Applicable CSP, Interconnection, and Retail Agreements	CSP schedule, and applicable class retail schedule and standby rider
"No Sale"	All types	Retail and Interconnection Agreement	Applicable class retail schedule and standby rider

**** In some cases the interconnection agreement will be a part of the CSP, PV, or Retail Agreement.***

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Renewable Energy Tax Credit (Corporate)

Incentive Type: Corporate Tax Credit

Eligible Renewable/Other Technologies: Passive Solar Space Heat, Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Solar Thermal Process Heat, Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric, Renewable Transportation Fuels, Spent pulping liquor, Solar Pool Heating, Daylighting, Anaerobic Digestion, Ethanol, Methanol, Biodiesel

Applicable Sectors: Commercial, Industrial

Amount: 35%

Maximum Incentive :$2.5 million per installation

Carryover Provisions: Credit is taken in five equal installments; allowable credit may not exceed 50% of a taxpayer's liability for the year, reduced by the sum of all other credits.

Eligible System Size: No stated size limits for systems. Maximum of 50 kWh battery storage capacity per kW of hydro generator capacity (DC rated); maximum of 35 kWh battery storage capacity per kW for other technologies

Equipment/Installation Requirements: System must be new and in compliance with all applicable performance and safety standards. Specific equipment and installation requirements vary by technology

Just my opinion

- Obtain guidance upfront from experienced engineer and equipment provider, before settling on interconnection and metering rate choices.
- Select a short term contract for the utility rates, REC's and carbon credits.
- Don't over estimate AD production and understand seasonal variations in output to avoid oversized generator.
- Consider CANbus control for engine-generator and grid protection integration.
- Don't start and stop the equipment to chase the TOU rate, rate penalties will take your profit and internal condensation will ruin the engine.
- Figure out how to use the waste heat to qualify for CHP REC's.

Do we have some questions?

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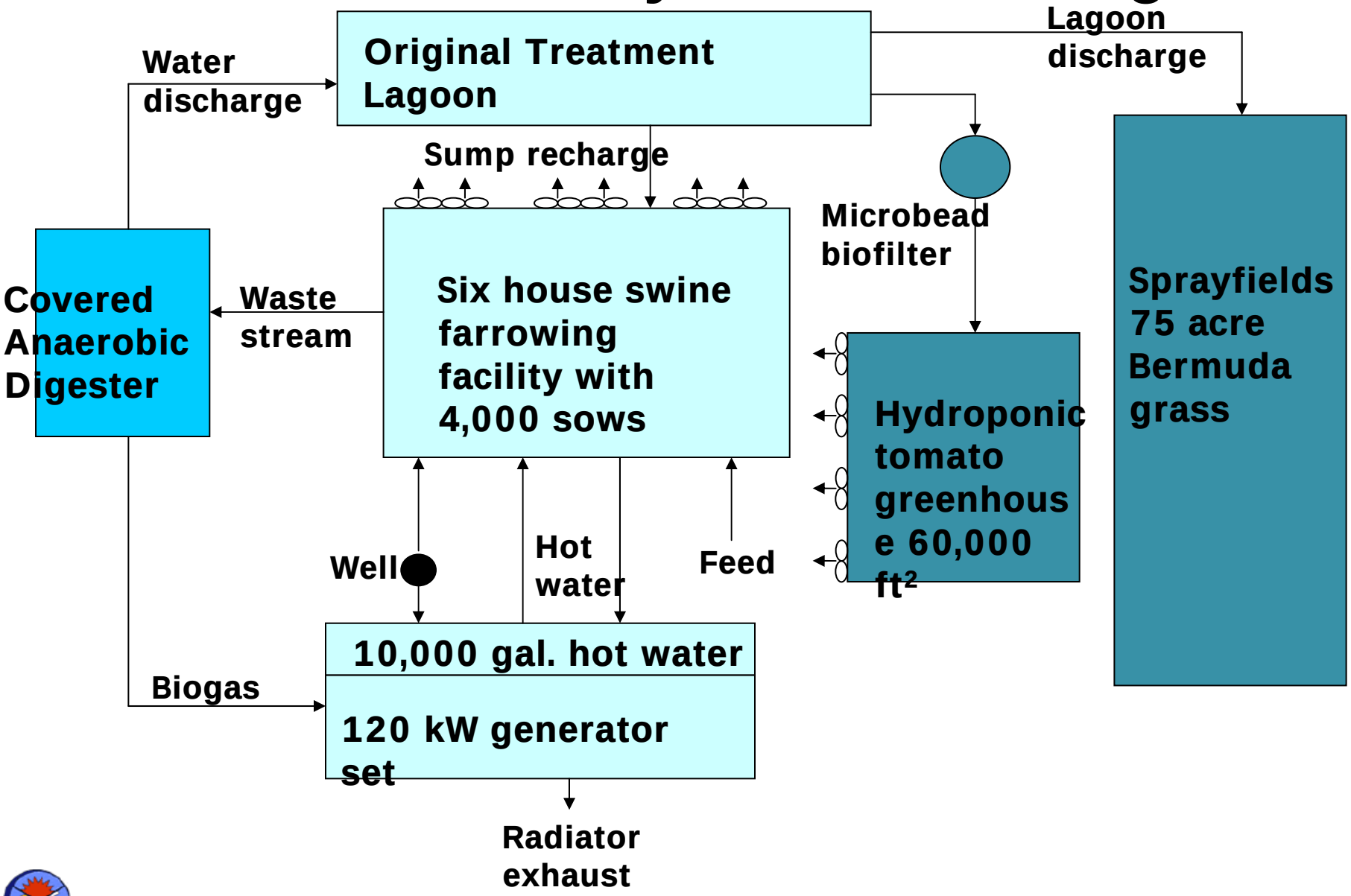
Barham Farms In-ground Covered Anaerobic Digester with CHP

Barham Farm system flow diagram

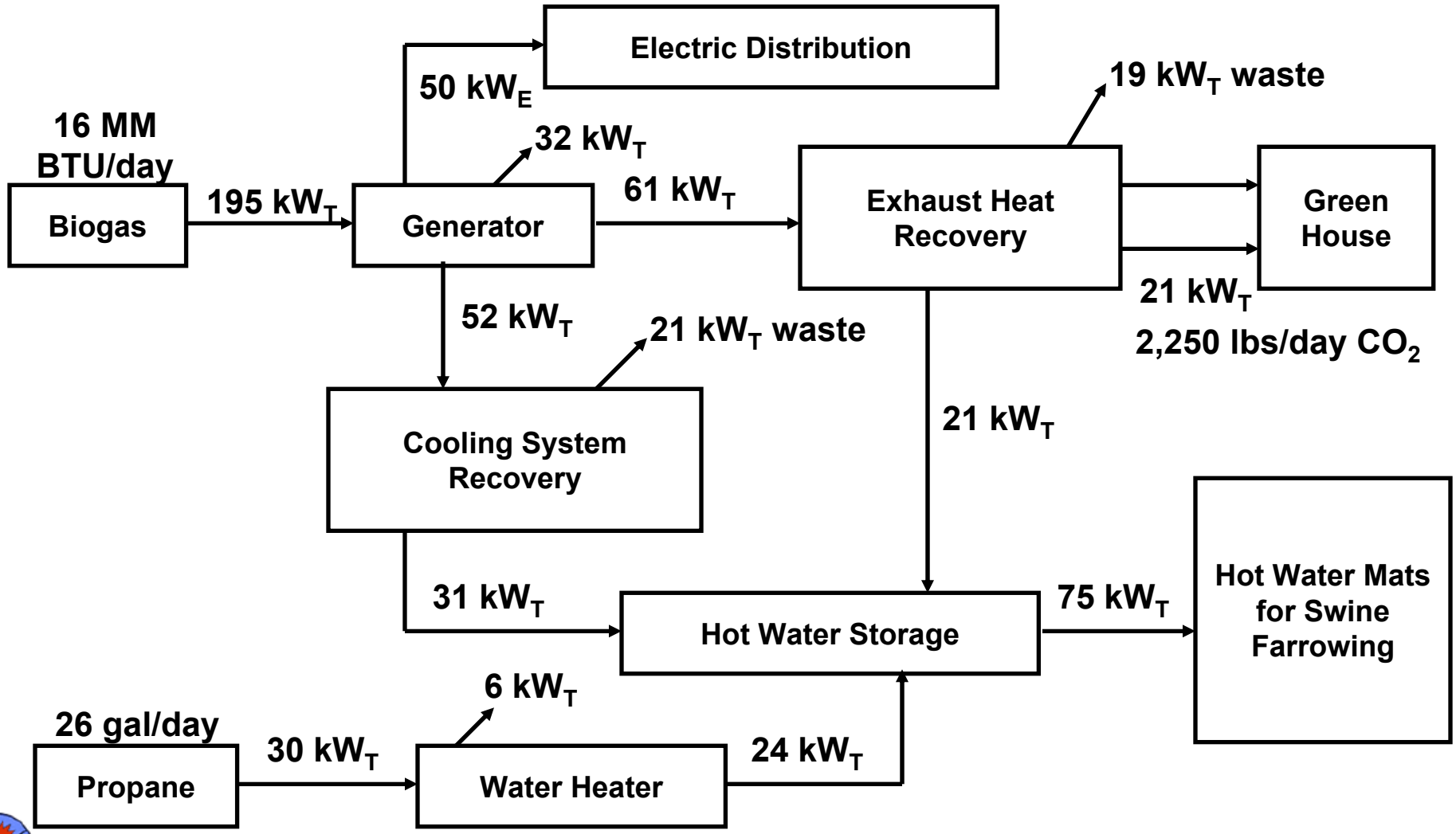


Anaerobic Digester fuels CHP

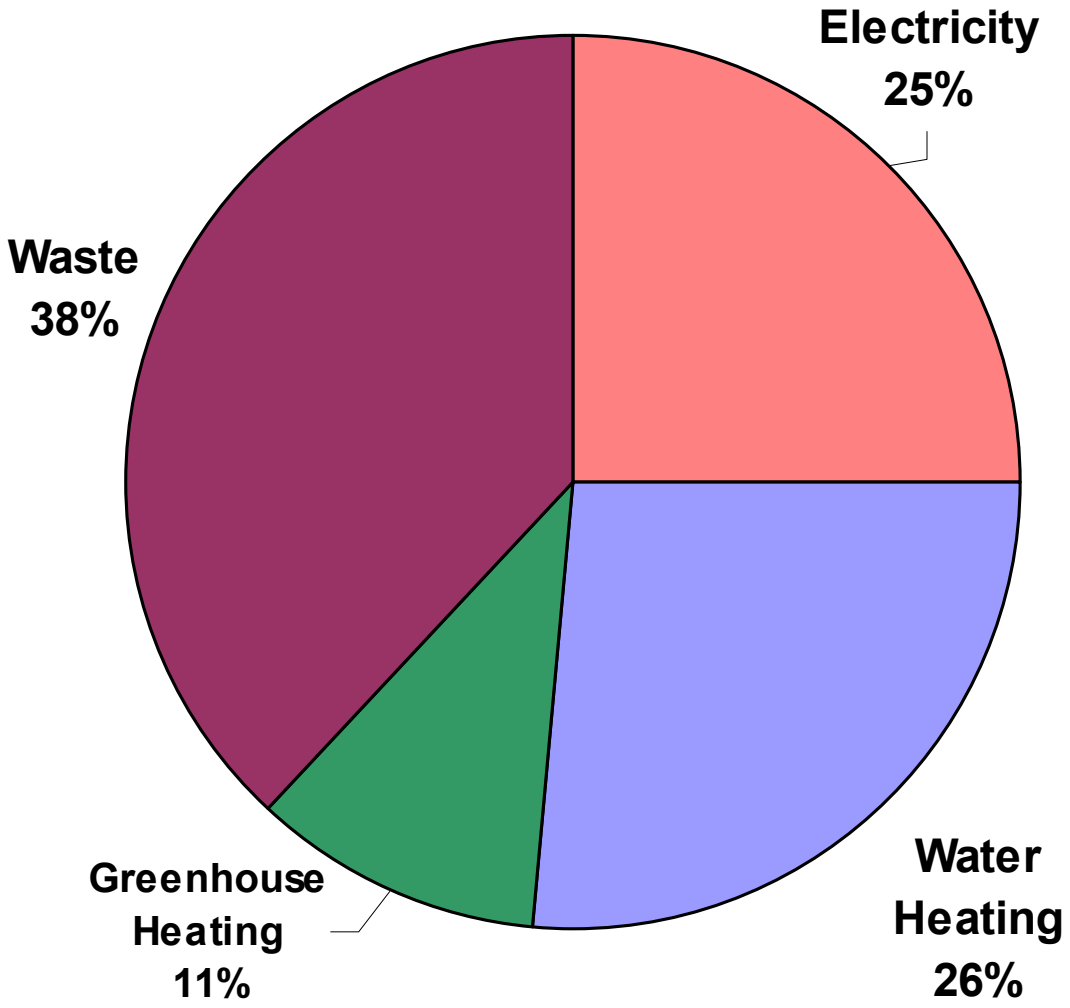
- Nutrients reduction
- Biogas production
  - 16 MM BTU/day

- Installed 120kW
- Radiator and Exhaust heat exchangers
- 10,000 gallons hot water storage
- Assume 50 kWe generator

Optimized CHP Sized for 50kWe Generator



Distribution of Fuel Usage



Energy Savings with CHP

Electricity not used for infrared heat	**+ $36,140 per year**
Electricity produced by generator	**+ $11,145 per year**
Propane for Boiler	**- $ 9,330 per year**
Total Savings	**$37,955 per year**

System Cost	**$192,600**
Simple Payback Time	**~ 6 years**

Emissions savings of CHP

Environmental effect of not using grid supplied power for infrared heaters while producing 50kWe from biogas on-site

CO_2	1,121,630 lbs/year
NO_x	2,505 lbs/year
SO_x	6,263 lbs/year
Particulate Matter	827 lbs/year

By using methane gas to create energy instead of releasing it into the atmosphere, overall greenhouse gas effects are reduced because methane has a GWP that is 23 times higher than carbon dioxide.

FUNDING OPPORTUNITIES

Progress Energy Carolina's Renewable Request for Proposals (RFP)

- Progress Energy has issued a request of proposals to meet the requirements of the North Carolina Renewable Energy Portfolio standards.
- Solar bids with nameplate capacity of 50 kW or greater, or non-solar bids with nameplate capacity of 10 MW or less will be accepted.
  - Priority will be given to those proposals with an anticipated commercial operation date prior to 2011.
- Bidding deadline is November 11, 2008
- Bidders will be notified by March 1, 2009 of Progress Energy Carolina's intent to enter further discussions.

http://www.progress-energy.com/environment/ras/rfp/index.asp

DSIRE

Federal – Expires end of 2008
Renewable Electricity Production Tax Credit (PTC)

Incentive Type: Corporate Tax Credit

Eligible Renewable/Other Technologies: Landfill Gas, Wind, Biomass, Hydroelectric, Geothermal Electric, Municipal Solid Waste, Refined Coal, Indian Coal, Small Hydroelectric

Applicable Sectors: Commercial, Industrial

Amount:2.0¢/kWh for wind, geothermal, closed-loop biomass; 1.0¢/kWh for other eligible technologies. Applies to first 10 years of operation.

Website:http://www.irs.gov/pub/irs-pdf/f8835.pdf

Local Option Green Building Incentive

Incentive Type: Green Building Incentive

Eligible Efficiency Technologies: Comprehensive Measures/Whole Building

Eligible Renewable/Other Technologies: Passive Solar Space Heat, Solar Water Heat, Solar Space Heat, Photovoltaics, Wind, ***Biomass***, Geothermal Heat Pumps, Daylighting, Small Hydroelectric

Applicable Sectors: Commercial, Residential

North Carolina Green Business Fund

Incentive Type: Industry Recruitment/Support

Eligible Efficiency Technologies: Comprehensive Measures/Whole Building, Custom/Others pending approval, Yes; specific technologies not identified

Eligible Renewable/Other Technologies: Passive Solar Space Heat, Solar Water Heat, Solar Space Heat, Solar ***Thermal Process Heat***, Photovoltaics, Wind, ***Biomass***, Hydroelectric, Renewable Transportation Fuels, Geothermal Heat Pumps, ***CHP/Cogeneration***, Hydrogen, ***Renewable Energy Technologies***, Tidal Energy, Wave Energy, Refueling Stations, Renewable Fuels, Other Distributed Generation Technologies

Applicable Sectors: Commercial, Nonprofit, Local Government, State Government, Agricultural, Institutional

Amount: Varies by award

Max. Limit: $100,000N.C. General Assembly (general appropriations)$1 million (FY 2007-08)

Renewable Energy Tax Credit (Personal)

Incentive Type: Personal Tax Credit

Eligible Renewable/Other Technologies: Passive Solar Space Heat, Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Solar Thermal Process Heat, Photovoltaics, Wind, ***Biomass***, Hydroelectric, Renewable Transportation Fuels, Spent pulping liquor, Solar Pool Heating, Daylighting, Ethanol, Methanol, Biodiesel

Applicable Sectors: Commercial, Residential, Multi-Family Residential

Amount: 35%

Maximum Incentive: $1,400 - $10,500 (varies by technology); $2.5 million for commercial applications

Carryover Provisions: Single-family dwellings: excess credit may be carried forward five years; all other property: credit taken in five equal installments; allowable credit not to exceed 50% of taxpayer's liability for the year, reduced by the sum of all other credits.

Eligible System Size: No stated size limits for systems. Maximum of 50 kWh battery storage capacity per kW of hydro generator capacity (DC rated); maximum of 35 kWh battery storage capacity per kW for other technologies

Equipment/Installation Requirements: System must be new and in compliance with all applicable performance and safety standards. Specific equipment and installation requirements vary by technology.

DSIRE

NC GreenPower Production Incentive

Incentive Type: Production Incentive

Eligible Renewable/Other Technologies: Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric, Anaerobic Digestion

Applicable Sectors: Commercial, Industrial, Residential, Nonprofit, Schools, Local Government, State Government, Agricultural, Institutional

Amount: Varies by technology and customer demand for NC GreenPower

Terms: Payments contingent on program success

REPS Regulatory Resolution

REPS Utility Comm Activities

- Interconnection, Docket No E-100, Sub 101 - new rules issued in June adopting a blend of the FERC SGIP and the NC rules (directed in REPS legislation). The 3 IOUs procedures were submitted and approved. The docket was reopened in August by Duke objecting to disconnect switch ruling - filed a motion for reconsideration of the Commission decision that an external disconnect was unnecessary on up to 10 kw inverter based systems.
- Net Metering, Docket No E-100, Sub 83 - consideration of expanding the limit for unit size to 1 MW (directed in REPS legislation), Procedural Schedule (ie. written evidentiary hearing) (Aug-Nov), Public Meetings in Raleigh (9/30) and Charlotte (10/2)

REPS Utility Comm Activities

- Study of Rates and Policies to Promote a mix of generation and energy conservation (directed in REPS legislation), Docket No E-100, Sub 116 - ordered a sequence of 3 comment filings. Closed, and Commission was to submit the study on September 1, 2008 to Governor, ERC and Joint Legislative Utility Review Committee.

- Rulemaking for the REPS, Docket No E-100, Sub 113 - rules were issued end of February and docket was closed. The docket was reopened in July for the NCSEA submission of design specifications of an electronic tracking system. Awaiting Commission Order.

REPS Utility Comm Activities

REPS Implementation - Energy Efficiency

- Duke's Save-A-Watt Proposal, Docket No E-7, Sub 831 - awaiting Commission decision, spawned (PBF) NCSaves$ Docket
- NCSaves$, Docket No E-100, Sub 120 - a PBF with an independent 3rd party administrator to conduct energy savings program, opened for comment Sep-Oct
- Progress' Residential Solar Hot water Proposal, Docket No E-2, Sub 928 - approved program but separate docket for cost recovery (No E-2, Sub 931)
- Progress Distribution System/Demand Response Proposal, Docket No E-2, Sub 926 - proposal to upgrade distribution system and claim it is DSM with hearing date set for Dec
- Progress EE/DSM Cost Recovery, Docket No E-2, Sub 931 - hearing date set Dec

REPS Utility Comm Activities

REPS Implementation – Renewable Energy

- Progress REC Contracts Cost Recovery, Docket E-2, Sub 930 - awaiting Commission order (Jun-Sep)
- Duke's PV DG Proposal, Docket E-7, Sub 856 - proposes to lease roof-tops, 700-750 3kw - 10kw and around 50 50kw - 3 MW PV systems - opened for comment Sep-Oct

SESSION LAW 2007-523
SENATE BILL 1465

Law Summary

- Codify and make permanent the swine farm animal waste management system performance standards passed in 1998.
- Provide the replacement of a lagoon that is an imminent hazard
- Assist farmers to voluntarily convert to innovate animal waste management systems
- Establish the swine farm methane capture pilot program.

Implementation

- Each electric public utility that serves a swine farm that is selected for participation in the pilot program is required to purchase all electricity generated by the use of captured methane as a fuel by pilot program participants for seven years.
- The total of all electric power purchases under the program will not exceed 25 megawatts at any point in time.
- The seven-year period begins on the date the swine farm first sells electricity to the electric public utility and ends seven years after the date on which the period begins.
- The Commission will set a suggested purchase price that would allow program participants to recover reasonably and prudently incurred capital and operating costs and that would minimize the impact of the pilot program on ratepayers.
- The price of power purchased under the program shall be determined by agreement between each program participant and the electric public utility.

Purchase Price Agreements

- Each purchase price agreement shall take into account the extent to which any capital or operating costs are paid to the program participant from any other source, including grants.
- A purchase price agreement may be revised at any time by agreement between the parties.
- If a program participant and an electric public utility cannot agree on a purchase price, the Commission will set the purchase price.
- A purchase price cannot exceed eighteen cents (18¢) per kilowatt hour.
- The Commission, with the advice of the Public Staff, may review any agreement between a program participant and an electric public utility.
- All costs incurred by an electric public utility to comply with the provisions of this section may be recovered as costs of fuel pursuant to G.S. 62-133.2.

Funding

- The Swine Farm Waste Management System Conversion Account is located within the Division of Soil and Water Conservation of the Department of Environment and Natural Resources
- Funds in the account shall be used only as provided in subsection (b) of Section 2 of this act.
  - Lagoon Conversion Program
- The account consists of funds appropriated by the General Assembly; any federal funds available for this purpose; and any grants, gifts, or contributions to the State for this purpose.
- Funds in the Account shall not revert.